

ACHIEVING, LABORING, AND SURVIVING: POSITIONING THROUGH MATERIAL AND IDEATIONAL IDENTITY RESOURCES IN STUDENT AUTOBIOGRAPHY

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This study examined the identity resources used and the subject positions taken by secondary students in autobiographical narratives of their experiences with mathematics (mathographies). Data consisted of mathographies from 54 students in two differently tracked math courses at a large, diverse public high school in Brooklyn, NY. The study asked 1) What material resources do students use to position themselves as different kinds of mathematics students? What typology of mathematics identities is revealed? And, 2) What ideational resources do students use to position themselves as different kinds of mathematics students? Findings revealed three predominant mathematics subject positions: celebrated high achiever, earnest laborer, and trauma survivor. Ideational identity resources included discourses of mathematics, of America and American schooling, and of race, language, and immigration.

Keywords: Equity and Diversity, Identity, High School Education

Mathematics is a high status, high power discipline—one that confers special status on those with recognized facility in the content and practice (Apple, 1993). The notion that there exists such a thing as a ‘math person,’ and assumptions about who gets to be one, are connected to issues of power. Who is seen as smart, who has a pathway to college, and who has access to an upwardly mobile career are all connected through the status of mathematics as a gatekeeper in American society (Martin, Gholson & Leonard, 2010). Even with increasingly abundant research that conceptualizes learning as a process of inclusion, participation and belonging (e.g. Wenger, 1998), questions that examine the conditions of possibility for belonging are still left largely unattended in mathematics education research.

Students, teachers and schools are faced daily with the high-stakes negotiation of who is recognized as a ‘math person,’ and students from historically marginalized groups in particular have especially complicated access to this high-status marker of success. Studies of the educational landscape of the United States often use demographic data to document stratification at the levels of both access and achievement for young people in mathematics. These studies repeatedly demonstrate inequitable outcomes (National Center for Education Statistics, 2013), as well as inequitable opportunities, (Storage, Horn, Cimpian & Leslie, 2016) along the lines of race, ethnicity, language, gender, (dis)ability and socio-economic status. Even as some research has shifted from a focus on an outcome-oriented “achievement gap,” to an input-oriented “opportunity gap,” these studies still tell an incomplete story. Adding an otherwise absent dimension to this work, recent scholarship demonstrates ways in which schooling, and even mathematics learning itself, can include “*racialized forms of experience* [emphasis original]—that is, ... experiences where race and the meanings constructed around race become highly salient” (Martin, 2006, p. 198). Beyond its well-understood status as gatekeeper, mathematics education has the potential to reproduce racialized experiences present in other aspects of social, political and economic life.

In one example of racializing experiences found in mathematics learning spaces, Shah & Leonardo (2016) share the story of a South Asian American student, Akshay, who performs at a

high level in his AP Calculus course only to find his effort dismissed by a classmate who comments that he simply does well because he is Indian. In the same school, a Black student, James, is treated with surprise and even disbelief when his classmates see that he is enrolled in an advanced math course. As these examples suggest, mathematics education may actually contribute in complex ways to *minoritization* – the formation of a marked minority status due to racial, ethnic, linguistic, immigration or another social status that diverges from an historical or ideological norm (Omi & Winant, 2002).

Contrary to the popular belief that mathematics is culture-neutral or culture-free, research in the last decade has begun to illuminate how mathematics teaching and learning may play a role in the process of minoritization (e.g. Shah & Leonardo, 2016). Minoritizing experiences of mathematics are particularly problematic because they function to “other” certain students in both their successes and their failures, reproducing exclusive notions of who gets to participate or belong within the discipline of mathematics. Throughout this paper, the word “minoritized” references a broad group of young people for whom their status as a minority is often constructed in direct contradiction to their numerical presence in their school, neighborhood, or even city. This contradiction makes clear the need to understand how this status is produced and reproduced, and in particular what role mathematics education plays in this process.

With these concerns in mind, mathematics education research has begun to attend to the identities of minoritized youth in mathematics, both by asking about the math learning experiences of specific social groups, and by asking about how mathematics identities are shaped by being part of a social identity group (Berry, Thunder & McClain, 2011). Studies of identity, often understood as including both the ways a student defines themselves as well as how they are perceived by others, have the ability to bring together questions about learning, participation and inclusion. However, even as identity has become widely accepted as a crucial analytic lens for understanding learning (Gee, 2000; Wenger, 1998), the ways that people understand and analyze identity in mathematics education vary significantly (Darragh, 2016; Langer-Osuna & Esmonde, 2016) and we still know little about the interaction between, and co-construction of, social and academic identities in mathematics. Furthermore, we know almost nothing about the *identity resources*—ideas, materials and relationships (Nasir & Cooks, 2009)—that students draw upon or how they use them in order to make sense of themselves in the world of mathematics. In order to explore this gap, the research questions guiding the study were:

1. What material resources do students use to position themselves as different kinds of mathematics students? What typology of mathematics identities is revealed?
2. What ideational resources do students use to position themselves as different kinds of mathematics students?

Methodology

This study took a new approach to understanding the identity work of young people. By looking at the discourses that students draw upon, and analyzing how students use these discourses as identity resources, this work provides insight into the conditions of possibility that shape and constrain student identities in mathematics. By examining *mathographies*—narrative autobiographies of student experiences with mathematics—written by Brooklyn high school students in response to a prompt from their math teacher, this work centers student voices as they describe and comment on their own experiences. Discourse analysis was used to illuminate the sets of language and ideas that students drew upon as identity resources and to identify common

subject positions that students took as they positioned themselves as different types of math students.

Context and Data

The 54 mathographies examined in this study were written by students enrolled in a Regents Algebra 2 and Trigonometry course (n=29) and students enrolled in a non-Regents Geometry course (n=25) at a large, racially and linguistically diverse public high school in Brooklyn, NY. In their mathographies, students mentioned over 20 language varieties and 15 different ethnic, racial, or national origin groups. Students in both courses were in the 10th or 11th grades. The mathographies ranged from one to six paragraphs and 200-1043 words. By examining the writing of students at the same school, and in the same grade band, but in two differently tracked courses, the sample attempted to account for a broad representation of experiences of success and perceived ability with regards to mathematics while holding other factors such as age, school site and teacher constant.

Mathography writing was an instructional activity assigned at the beginning of a new semester by one mathematics teacher to two classes of students. The activity was framed as both a “getting to know you” task and an opportunity for student reflection on previous learning experiences. Students had one week to complete and submit their written work to their teacher. The same writing prompt was used in both classes.

The questions in the writing prompt included inquiry into personal details about family and language, as well as questions about experiences with mathematics such as what does math at home look like, when have you learned the most math, and have you ever had a ‘math moment’? Students were also invited to share hopes and dreams for the future and something a math teacher might not know about them if they only knew them in math class. Students were prompted to respond in narrative form to any subset of the questions, provided it told a story of them and mathematics. They did not have to respond to all questions in the prompt.

Coding and Analysis

This study made use of discourse analysis (Wortham & Reyes, 2015), examining student language in their mathographies in order to map the ways in which their language use both served to situate themselves within existing discourses and also at times worked to challenge those discourses. Discourse analysis allowed the researcher to track the linkages between micro-interactive moments and social structures at the institutional and societal levels. Insight into how the micro and macro work together is essential in the treatment of identity and mathematics education. As students negotiate identity they do so drawing not only on classroom-based interaction but also on their full repertoire of experiences as members of the social, cultural, and political world.

Discourse analysis entails identification of patterns both within and across “speech events” (Wortham & Reyes, 2016). In this study, the speech event unit was one mathography (n=54) and the speech act unit was a paragraph (as demarcated by students using conventional line breaks or indentation) (n=233). Coding schema were developed through open coding, and then focused coding was used to further nuance the coding schema (Emerson, Fretz & Shah, 2011). Analysis was conducted through the use of analytic memos. Strategic searches for code co-occurrence and patterns across the memos were conducted using both Excel and Dedoose, a qualitative coding software.

Coding was conducted in three phases. The first phase of coding and analysis focused on research question 1, *What material resources do students use to position themselves as different kinds of mathematics students? What typology of mathematics identities is revealed?* First, I

identified speech acts (paragraphs) in which students made claims about themselves as mathematics learners or recounted others making claims about them as particular types of mathematics students (n=148) and wrote an analytic memo for each. Patterns were noted in the identity claims being made by students. The memos were compared and cross referenced such that it was possible to propose a typology of mathematics student identity positions that accounted for all of the instances. These speech acts were then also coded for material evidence and analysis identified the material evidence most commonly associated with each identity position from the typology.

The second phase of coding and analysis focused on research question 2, *What ideational resources do students use to position themselves as different kinds of mathematics students?* This phase started by re-examining the speech acts that included student positioning and the material resources that students used to position themselves in order to identify the discourses of mathematics that students were drawing on in these moments. Another round of analytic memos were written for each positioning act. These memos asked for each positioning act, how does the student frame mathematics in the world. Specifically, memos addressed “what is math?”, “mathematics for what?” and “mathematics for whom?” for each positioning act. In order to expand from discourses of mathematics to other potential discourses at play, a third phase of coding identified speech acts in which students positioned their families, languages, culture or nation of origin in relation to their own experiences of mathematics (n=85). A final round of analytic memos were written examining each of these speech acts. Two additional discourse categories were identified: discourses of America and American schooling, and discourses of race and immigration, along with core sub-components of each discourse.

Findings

Three Math Student Subject Positions and the Material Evidence for Each

In response to research question 1, I identified three mathematics subject positions: *celebrated high-achiever*, *earnest laborer*, and *trauma survivor*, explained below. These subject positions can also be thought of as available identities that a mathematics student might assume, achieve, or have ascribed to them. In their mathographies, as students positioned themselves as particular types of math students, or recounted having been positioned by someone else, each student also provided evidence to substantiate the position. The evidence they provided reveals the *material identity resources* that students found available to them for making sense of themselves as different kinds mathematics learners. In the 54 mathographies, 24 students positioned themselves at one point as celebrated high achievers – those with status based on the visibility of their successes in math. Twenty-seven (27) students positioned themselves at one point as earnest laborers – those whose status relies on effort, and 21 students positioned themselves at one point as trauma survivors – those with a significant negative experience that has shaped their current orientation toward math. Note that the sum is greater than 54 (the number of individual mathographies) because many students made use of more than one position over the course of their mathography. A summary of the typology with the related material evidence and one example from each position is provided in Table 1.

Table 1: Typology of positional mathematics identities with material identity resources

Position	Material Resources	Example
Celebrated High Achiever (n=24)	Course grades	In school I was doing math like it was nothing. I was top in my class. But every year I'll have a competition with someone to get top place. Always someone that smarter than me. So I'll go home and try to be ahead, going to tutoring and asking my dad, freshman year I was a 95% average student in math had the best teacher, Ms. Alexander. That year math was my focus, I past every test with 95-100. That made the teacher and my parent proud. (MS23G)
	Test scores	
	Regents Exams	
	Course enrollment	
	Class rank	
	Awards	
	Competition	
Earnest Laborer (n=27)	Visibility (positive)	I'm really not that great in math but I somewhat like mathematics because every time I solve a math problem it makes me feel like I'm intelligent, I'm like everybody else, it's a challenge sometimes that comes with my best effort. Every time I use math in my daily life it greatly benefits me, that being said it is something I use every day and almost at any time especially when it's dealt with money. It's always been difficult for me to learn math, I sometimes feel as if math is like my kryptonite. I know I can't get every question right but at least I know I tried my best even if I don't know what I'm doing. (MS09T)
	Being first, being fast	
	Course grades	
	Test scores	
	Regents Exams	
	Too much content, too fast	
	Attending tutoring	
Trauma Survivor (n=21)	Homework completion	My most negative math moment would be long dividing in the fourth grade. I absolutely hated it, and most of my peers already knew how to do it. Which made me more embarrassed to know that I was the only one in the class that didn't know how to do it. Another negative would be in the 6th grade where I basically got 60s on all my math tests because I didn't get what he was teaching as well as how I even got a 65. I was at the lowest level of dumb in math. (MS26T)
	Learning steps and procedures	
	Practice and repetition	
	Course grades	
	Test scores	
	Regents Exams	
	Course enrollment	
	Competition	
	Public humiliation	
	Being last, being slow	
	Visibility (negative)	

Three Discourses as Ideational Resources

Findings showed that students used cultural and institutional discourses as ideational resources as they positioned themselves, their families, languages and cultures or nations in relation to mathematics. The discourses they used throughout were *discourses of mathematics*, *discourses of American schooling and meritocracy*, and *discourses of race, language, and immigration* in the United States. An overview of the three discourses that students drew upon as identity resources, and the core components of each, as used by students is found in Table 2.

Dominant Discourses of Mathematics. Findings show that even as students relied on varied material resources to position themselves as different kinds of mathematics students, the material resources they used point to a set of widely shared dominant discourses of mathematics itself. Those discourses were that 1) mathematics ability is innate and fixed, and 2) mathematical competence is comparative, exclusive, and measurable through time constrained performances, usually of procedures. These discourses are visible throughout the examples shared in Table 1.

For example, one Algebra 2/Trig student wrote, “I’m really not that great in math” (MS09T), reflecting the perceived fixed-ness of her mathematics ability status. A Geometry student marks her competence through indicators of ease and comparison to her classmates, followed by a description of a competition to prove her status: “In school I was doing math like it was nothing. I was top in my class” (MS23G).

Discourses of American Schooling and Meritocracy. In their mathographies, students also drew on discourses of schooling and the American social context more broadly, layering these with the dominant discourses of mathematics. The two core components of discourses of America and American schooling that students drew upon were 1) Innate ability in tension with development psychology and lived experience and 2) American meritocracy as advancement through legitimate systems that reward both innate talent and work ethic. Whereas discourses of mathematics elevate ideas about innate talent, which are corroborated in discourses of American meritocracy, discourses of American schooling and meritocracy offer an alternative but well-established narrative that elevates the importance of lived experience as well as the merits of hard work. Students who positioned themselves as earnest laborers or trauma survivors wrote about challenges faced and overcome through personal effort and perseverance that shaped the student’s relationship with mathematics.

Discourses of Race, Language and Immigration. American liberal ideals that value both individual ambition and competition as well as egalitarianism are complicated by the pressures of assimilation for minoritized racial and ethnic groups and immigrants in the United States. Both standing out and fitting in are complicated for minoritized students. Furthermore, discourses of racial inferiority, both genetically and in terms of educational attitudes, sit as a backdrop, in particular for minoritized students, as they attempt to position themselves with worth and dignity in front of their current math teacher. Throughout their mathographies minoritized students consistently explained experiences of visibility – both positive and negative – as attributable to some form of racial, ethnic, linguistic or cultural experience of difference. They describe experiences of confronting ideologies of racial and linguistic inferiority and they draw on discourses of cultural deficiency themselves. One student wrote,

The most negative experience happened in second grade. My teacher at that time didn’t try to teach me but also made fun of me. I didn’t know that much English at time and some of the math problems were in words. It was really difficult to me. My teacher gave up on me but she didn’t try at all. She insisted that I should go get my ears checked. She also asked if I’m a mute (MS16T).

At the same time, many more students position themselves and their families as model minorities, citing appropriate attitudes toward education and orientations of aspiration and investment that make them stand out in their success, or, if not in their success, at least in their work ethic. One student attributes her own success to her immigrant parents, positioning their attitude toward mathematics as the appropriate one:

Having parents that find math one of the most important subjects in school shaped me to be how I am in math class today. I’ve always found math to be an easy subject to wrap my head around; getting 4’s on my state tests. ... Whenever my parents talk about currency I love to convert the dollars to taka (Bangladesh currency) with a pen a paper instead of just searching it up on google. It’s nice when I get the calculations correct (MS03T).

Table 2: Discourses used as ideational identity resources in student narratives

Dominant Discourses of Mathematics	Discourses of American Schooling and Meritocracy	Discourses of Race, Language, and Immigration
Mathematics ability as innate and fixed	Innate ability in tension with psychology, development, and lived experience	Ideologies of racial and linguistic intellectual inferiority
Mathematics competence as comparative, exclusive, procedural, and time-bound	American meritocracy, work ethic, and advancement through investment in legitimate systems	Discourses of deprivation and deficit alongside discourses of investment and models of success

Discussion

This study contributes to existing theory on the development of mathematical identities for young people by proposing new ways of understanding the identity work in which young people engage. The voices of students as heard through their mathographies reveal the resonance of discourses of mathematics, of schooling and American society, and of race and immigration in the United States. These discourses both shape and constrain the possibilities for how young people understand themselves and present themselves to the world. At the same time, these discourses act as available tools that students necessarily use when shaping ideas about themselves, and bidding for particular representations of themselves in the world.

Ideas about what math is significantly shape and constrain how students see themselves as different types of mathematics students and learners. The material evidence that students used to instantiate their various mathematics student positions demonstrates the limited nature of the notion of mathematics most readily available to students. Discussion of grades, tests, speed, awards, homework, attendance records, and comparisons to other students abound as students position themselves as mathematics students of a certain type. This reveals the extent to which student notions of mathematics are constrained by the dominant discourse of mathematics as a set of skills and procedures, measured comparatively and through time-bound mechanisms. Students position themselves with self-worth and merit in front of their math teacher within the constraints of this dominant discourse of mathematics. Their reliance on the positions of celebrated high-achiever, earnest laborer and trauma survivor likely reveals more about the ways that dominant discourses in mathematics shape the identities available to students than it does about the students themselves as participants in or learners of mathematics.

Discourses of American ambition and American meritocracy complicate and constrain how minoritized students see themselves and present themselves because the meanings behind visibility and achievement have different stakes when they are racialized. Discourses of American society both resonate with and diverge from the dominant discourses in mathematics. As is true in mathematics, American ideals celebrate ambition, standing out and high achievement, especially as compared to others. At the same time, American ideals of hard work, labor and perseverance act as an alternative axis of merit available to students for whom traditional high achiever positions are inaccessible. In their mathographies, students drew widely on the American ideals of hard work and perseverance, presenting their own efforts as valuable and as deserving of recognition, both when they told stories of high achievement, and when their efforts were called upon to stand in the place of high performance.

That said, standing out and fitting in are inscribed with different meanings when the students doing so are racialized or minoritized as existing outside of the dominant norm. Fitting in, when it means assimilation, can be high stakes. Where students associated family or language with

negative visibility they often employed deficit discourses to themselves or their home lives. At the same time, where minoritized students experienced positive visibility it was often framed as standing out as compared to other minoritized students. Rather than being celebrated as an exceptional student (full stop), the celebration was of being a model *minority* student. As seen in their mathographies, young people work consonantly to find ways to understand and position themselves as worthy mathematics students, often contesting the centrality of innate ability. However, if the other most readily available discursive tools are the also-racialized American myths of hard work and meritocracy, student options remain severely constrained.

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